

UNIVERSITY OF SASKATCHEWAN
College of Engineering

GE 210.3
Probability and Statistics

Final Examination

Time: 3 hrs.

Six Questions

Date: December, 2004

Note: A student may bring in three sheets (8.5 x 11) of formulae but no solved problems (in whole or in part) allowed. Calculators allowed. Six pages of statistical tables are attached.

MARKS

(16) 1. A company has set up a production line for cans of carrots. The numbers of breakdowns on the production line over 49 shifts are summarized as follows:

Number of breakdowns in one shift	Number of shifts
0	17
1	13
2	8
3	6
4	3
5	2
>5	0

$$\chi^2_{\text{obs}} = 5.99$$

$$\chi^2_{\text{crit}} = 5.99$$

a) At the 5% level of significance, is this distribution different from a Poisson Distribution? State and prove your hypotheses. 5.63 breakd/wee

b) An employee works four shifts during a workweek on this production line. What is the average number of breakdowns that employee would expect during a normal workweek?

(16) 2. It is known that soil density varies as depth below the surface. At a certain location, soil density (y in Mg/m³) was measured at 15 depths (x in m.) An analysis gave the following results:

$$\Sigma x = 5.55, \Sigma x^2 = 2.255, \Sigma y = 33.15, \Sigma y^2 = 73.643, \Sigma xy = 12.493.$$

a) Find the regression equation for y on x. b: 1.129 a) 1.792

b) Find the 95% confidence limits of the mean value of y for x = 0.42 m. That is, if many samples are taken at a depth of x = 0.42 m, what are the 95% confidence limits for the mean density of these samples?

c) Find the correlation coefficient r. r = 0.8205

(20) 3. A modification to a chemical process is being considered to reduce the production of an undesirable byproduct. Two production units are fed the same raw materials and operate under the same conditions, except that unit A uses the standard process, and unit B uses the modified process. A random sample from unit A gives the following percentages of the byproduct: 2.1, 1.8, 2.3, 2.4, 1.9, 2.2, 2.5, 2.0. A random sample from unit B gives the following percentages of the byproduct: 1.7, 1.4, 2.2, 1.6, 1.9, 1.5, 1.8, 1.3.

a) Is there a significant difference in variability between the two samples?
 State your hypotheses, choose an appropriate level of significance and prove your hypotheses. $f_{crit} = 3.79$ $f_{obs} = 1.4167$

b) Does the sample from unit B show a significantly lower mean percentage of the byproduct? Use the 0.025 level of significance.
 $t_{crit} = -2.145$ $t_{obs} = -3.528$

(16) 4. It is known that of the concrete used by a sidewalk contractor, 20% comes from Plant A, 30% from Plant B, and the rest from Plant C. The mean strengths of the concrete from Plant A, Plant B and Plant C are 30 MPa, 29.11 MPa, and 30 MPa respectively. The corresponding coefficients of variation are 0.0486, 0.05, and 0.0624.

a) What is the probability that a randomly selected load of concrete will meet the specified strength of 27.6 MPa? 0.895

b) The City tests only 10% of the loads of concrete. If the profit margin on concrete is \$10/m³, but the contractor is penalized \$50/m³ for concrete that is found not to meet the strength specification, what is the expected gain(loss) per cubic metre? $89.48/m^3$

(16) 5. One hundred sites in a certain district were investigated for oil based contaminants. Three contaminants, A, B, and C, were of particular interest. It was found that at 25 of the sites, contaminants A and B were both present. At 10 of the sites, none of the contaminants were present. At 29 of the sites, contaminants A and C were both present. Contaminant A was present in 47 sites, and contaminant B was present in 46 sites. All 3 contaminants showed up at 12 sites. Contaminants B and C, but not A were present at 13 sites.

a) What is the probability that a site selected at random will be contaminated with B or C or both? 0.850

b) Given that the site is contaminated with B, what is the probability that it is contaminated by all three components? 0.261

c) Given that the site is contaminated by fewer than two contaminants, what is the probability that it is not contaminated at all? 0.222

(16) 6. A certain golfer has an average pace of 0.85 metres with a standard deviation of 0.07 metres. It can be assumed that his pace follows a Normal Distribution and that the paces taken in series are independent.

a) Determine the 90% confidence limit for the actual distance between two points when the golfer "paces" it as 60 paces. $(50.1 \text{ to } 51.89) \text{ m}$

b) What is the maximum distance that he can "pace" off and still have an 80% probability of the distance estimated by "pacing" being within +/- 2.0 metres of the true distance. 473.3 m

***** END OF EXAM*****